UNION SWITCH & SIGNAL

645 Russell Street
Batesburg, SC 29006

SERVICE MANUAL 3623

KP RELAY

Description, Installation and Maintenance

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UNION SWITCH & SIGNAL

REVISION INDEX

Revised pages of this manual are listed below
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Contents

Section			Page
I		GENERAL INFORMATION.	1
	1.1	INTRODUCTION.	1
	1.2	DESCRIPTION	1
	1.3	SPECIFICATIONS.	2
II		INSTALLATION	7
	2.1	GENERAL	7
	2.2	MOUNTING BASE	7
	2.3	RELAY INDEXING.	7
	2.4	RECEPTACLE SPRINGS.	7
	2.5	RELAY INSERTION	8
III.		FIELD MAINTENANCE.	9
	3.1	INTRODUCTION.	9
	3.2	SERVICE REQUIREMENTS.	9
	3.3	CLEANING.	9
	3.4	PERIODIC PERFORMANCE TEST	9
IV.		SHOP MAINTENANCE	13
	4.1	INTRODUCTION.	13
	4.2	CLEANING.	13
	4.3	INSPECTION.	13
	4.4	TEST EQUIPMENT.	13
	4.5	TESTS AND CHECKS.	13
	4.6	REPAIRS AND REPLACEMENT	14
	4.7	ADJUSTMENTS	19
	4.8	CALIBRATION	23
	4.9	OPERATIONAL TEST.	29
APPENDIX A		PARTS LIST	

SAFETY SUMMARY

Safety precautions that must be observed when performing certain tests are cross-referenced by test and paragraph number. The specific WARNING is placed prior to the performance of a particular step in a test.

TEST	PARAGRAPH NO.
When performing maintenance tasks, no additional safety precautions are required, other than common safety practices.	

SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

This service manual provides service information for style KP relays. The style KP designation includes a group of direct current two position polar-type relays. The fundamental design, physical dimensions, and general appearances of this entire group are identical, but the basic adjustments, contact combinations, coil resistances, and calibration values are furnished in various combinations for different applications. Because of the special fixtures required in the assembly of these relays, it is recommended that they be returned to the factory when major repairs involving replacement of parts are required. However, where facilities are available to handle major repairs, reference should be made to that particular section covered in this service manual.

1.2 DESCRIPTION

1.2.1 General

All KP relays are individually housed in molded bakelite cases with all operating parts fully enclosed and sealed. All contacts are visible through the front cover glass. The contact members are molded permanently in bakelite.

By means of basic magnetic adjustments made during manufacture, either of two different types of relays operation are provided, namely "stick" or "biased".

The armature of a stick type relay is operated into alternate positions (clockwise or counterclockwise) by opposite polarities, and remains in the last operated position when the coils are deenergized.

The armature of a biased type relay is operated clockwise (closing the front contacts) by normal polarity, and returns to the counterclockwise or "biased" position (opening the front contacts) when deenergized. Since the armature remains in the counterclockwise position when reverse polarity is applied, the biased relay functions as a sensitive biased relay.

Basic magnetic adjustments, in combination with various contact assemblies, also govern the wattage requirements of individual relays. It will be noted from the calibration tables that the operating levels range from approximately 150 to as low as 5 milliwatts.

1.2.2 Coils

KP relays have two coils which may be used either independently or in combination to suit requirements.

In addition, any given relay of either stick or biased type of fixed wattage can be furnished in a range of coil resistance from a fraction of an ohm to approximately 4,000 ohms per coil to provide for various circuit requirements.

1.2.3 Contacts

Contacts are permanently molded in bakelite and are visible through the front cover glass. The contact arrangements available provide for a multiple of circuit applications.

1.3 SPECIFICATIONS

The following paragraphs provide the electrical and mechanical specifications of the KP relays covered in this manual.

1.3.1 Electrical

Relay electrical specifications are tabulated in the following paragraphs.

1.3.1.1 KP Stick Type Relays, 4 Normal - 4 Reverse Non-Independent Contact, Contact Opening - Approximately 0.050 Inch

Part Number	Code Number	Relay Coils		Milliamperes Pick-Up	
		Location	Ohms Res.	Max.	Min.
N191493	45680	Upper Lower	105 20	45 90	25 55
N217122	12347	Upper Lower	105 105	45 45	25 25
N191500	45780	Upper Lower	1070 1070	14 14	9 9

Calibration values apply for both Normal and Reverse Pick-Up.

The make or break adjustment positions of both Normal and Reverse contacts of relays in above table are 0.025 inch on either side of midstroke position.

Tool N243001 is used to lock the armature in the correct positions of adjustment of the above relays.

1.3.1.2 KP Stick Type Relays, 2 Normal - 2 Reverse Independent Contacts, Contact Opening - Approximately 0.040 Inch

Part Number	Code Number	Relay Coils		Milliamperes Pick-Up	
		Location	Ohms Res.	Max.	Min.
N191499	45789	Upper Lower	20 20	30 30	20 20
N220821	56780	Upper Lower	1070 1070	5 5	3 3

Calibration values apply for both Normal and Reverse Pick-Ups.

The make or break adjustment positions of both Normal and Reverse contacts of relays in above table are 0.005 inch on either side of midstroke position. This provides a 0.010 inch transfer opening between the normal and reverse contacts.

Tool N243002 is used to lock the armature in the correct positions for adjustment of the above relays.

1.3.1.3 KP Stick Type Relays, 4 Normal - 4 Reverse Non-Independent Contact, Contact Opening - Approximately 0.026 Inch

Part Number	Code Number	Relay Coils		Milliamperes Pick-Up	
		Location	Ohms Res.	Max.	Min.
N347480	12457	Upper Lower	20 20	92 92	57 57
N371940	12458	Upper Lower	12.5 12.5	120 120	74 74

Calibration values apply for both Normal and Reverse Pick-Ups.

The make or break adjustment positions of both Normal and Reverse contacts of relays in above table are 0.015 inch on either side of midstroke position. This provides a 0.030 inch transfer opening between the normal and reverse contacts.

Tool N347547 is used to lock the armature in the correct positions for adjustment of the above relays.

1.3.1.4 Special KP Stick Type Relays (With Off-Center Adjustment), 2 Normal - 2 Reverse Independent Contacts, Contact Opening - Approximately 0.040 Inch

Part Number	Code Number	Relay Coils		Pick-Up Milliamperes			
				Normal (Clockwise)		Reverse (Counterclockwise)	
		Location	Ohms Res.	Max.	Min.	Max.	Min.
N231412	12357	Upper Lower	75 33	20.0 29.4	15.0 21.6	12.6 18.9	9.4 13.1

This relay is normally calibrated by first giving it the same mechanical contact adjustments as the standard stick type relay with 2N-2R independent contacts. Then the 0.005 inch off-center make or break adjustments slightly altered in order to increase the normal pick-up and decrease the reverse pick-up until the above specification is met.

When recalibrating the above type of relay, only sufficient alteration or correction of contact adjustments should be made to directly reproduce the above calibration without going through the basic procedure.

1.3.1.5 KP Biased Type Relays, 2 Normal - 2 Back Independent Contacts, Contact Opening - Approximately 0.030 Inch

Part Number	Code Number	Relay Coils		Milliamperes			
				Pick-Up		Working	Full Drop-Away
		Location	Ohms Res.	Max.	Min.	Max.	Min.
N225785	23456	Upper	12.5	50	30	55	15
		Lower	12.5	50	30	55	15
N294846	12367	Upper	20	35	25	45	10
		Lower	3800	3	2	3.7	1
N215618	12348	Upper	105	17	9	20	5
		Lower	105	17	9	20	5
N296500	12379	Upper	105	17	9	20	5
		Lower	1070	5.3	3.7	6.5	1.7
N191481	57890	Upper	1070	5.3	3.7	6.5	1.7
		Lower	1070	5.3	3.7	6.5	1.7
N240096	12340	Upper	3800	3	2	3.7	1
		Lower	3800	3	2	3.7	1

The make or break adjustement position of all four contacts of relays in the above table is the midstroke position of the armature.

With armature in midstroke position, all four contacts should be just on the point of making.

If there is more than approximately 0.001 inch opening (just a visible gap), it should be reduced until the gap is barely visible. This adjustment should be produced on all four contacts.

In no case should either front contact close before both back contacts open. They should either just make at the same point or be slightly open.

Tool N243000 is used to lock the armature in the mid-position for adjustment of the above relays.

1.3.2 Mechanical

The following mechanical specifications are common to all KP relays covered in this manual.

SECTION II

INSTALLATION

2.1 GENERAL

The KP relay is plug-connected for quick and easy replacement. Relays are keyed to plug connectors to prevent plugging the relay into an incorrect position.

Various size mounting racks are available for plug-in mounting on a horizontal shelf. Relays are wired from the rear on solder terminals. The relay(s) are plugged into connectors on the rack and can easily be removed for maintenance or replacement.

2.2 MOUNTING BASE

Bar supports are available for mounting up to seven KP relays on a rack. This support is arranged for all circuits to be wired directly to the relay plug connector solder terminals. The KP relay is inserted into plug connectors and secured with two hinged lock plates.

2.3 RELAY INDEXING

Means are provided in the relay case and plug connectors to prevent the plugging-in of a given relay into the wrong position. A combination pin plate is associated with each pair of plug connectors, and contain five pins in various combinations. Each separate piece number relay has an individual combination assignment. Slots are milled in the base of each relay to match this assignment. Accordingly, none but the correct relay can be plugged into a given connector position having slots matching pin positions. The numbers remaining on the base of the relay after slots have been cut identify the code combination for the relay.

2.4 RECEPTACLE SPRINGS

Each plug connector contains a number of receptacle springs which engage the relay fingers. To insure proper operation of the relay, the receptacle springs may be checked as follows:

a. With the relay in position it should be checked visually to see that each relay finger extends to or beyond the edge of its receptacle spring, thus providing an adequate contact.

b. With the relay removed from the plug connectors, a spring pressure check should be made on each receptacle spring. For a receptacle spring having proper pressure, a force of a least two (2) ounces should be required to remove a polished metal finger 1/64 in. thick inserted betweeen the spring and the bakelite. Spring gage N320728 was specially designed for this purpose.

2.5 RELAY INSERTION

The KP relay is inserted into the plug connector and secured with two hinged lock plates. Figure 1 shows a typical KP relay installation.

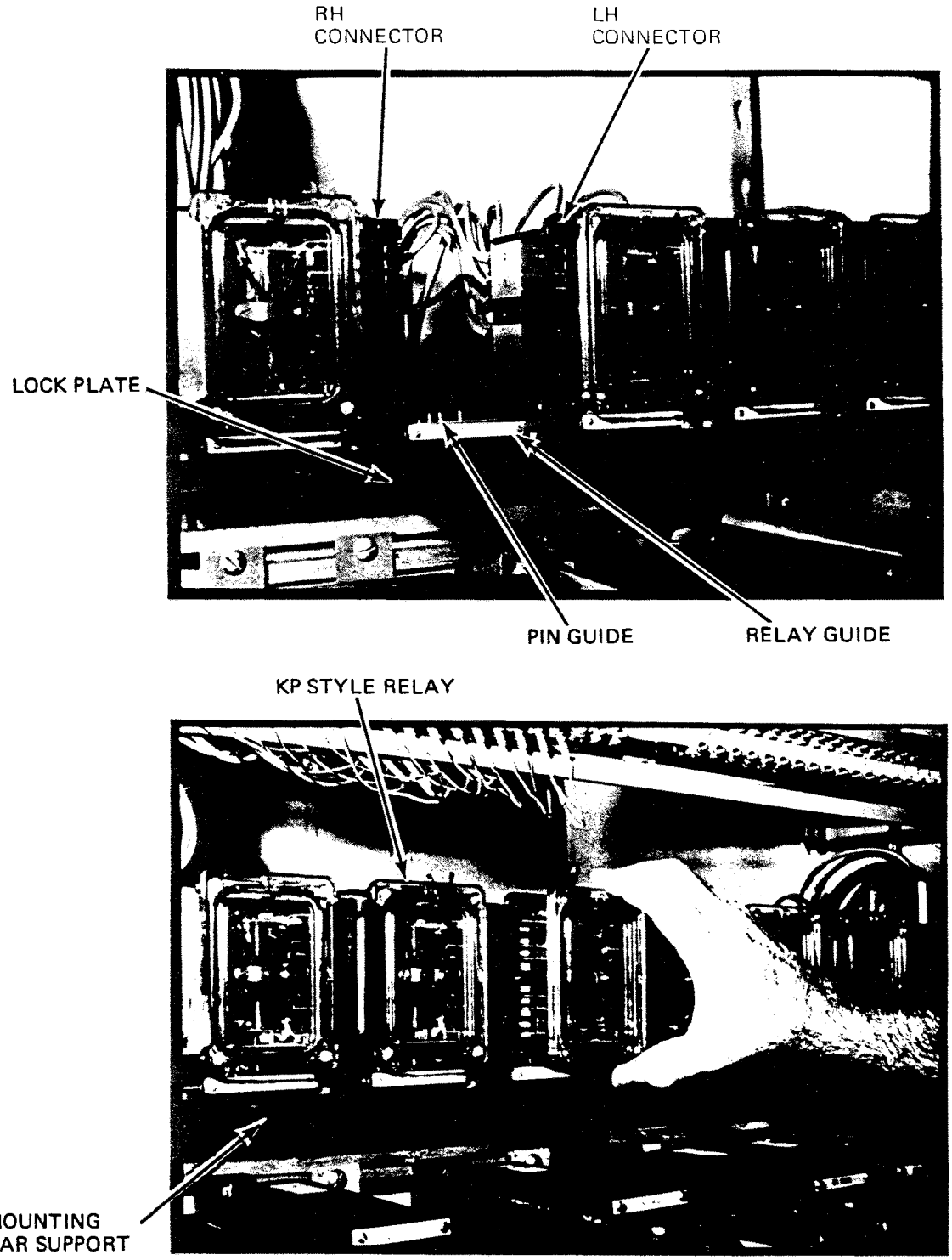


Figure 1. KP Relay Installation

SECTION III

FIELD MAINTENANCE

3.1 INTRODUCTION

The necessary periodic preventive maintenance procedures which must be performed to ensure continuous, proper, and efficient operation of the KP relays covered in this manual are provided in this section. Field maintenance covers periodic inspections and performance tests.

3.2 SERVICE REQUIREMENTS

If service (field) values are given in service instructions covering the equipment or system in which the KP relays are used, those recommendations should be followed. In the absence of such values, it is suggested that relays having a pick-up greater than 110% of the value shown in the tables of this service manual, or a drop-away less than 67% of the tabulated value, be taken out of service for recalibration.

3.3 CLEANING

For general cleaning, a small, dry fine-bristled (camel's hair) brush may be used. Contacts and stop pin surfaces may be cleaned by brushing lighly with a clean fine-bristled brush moistened with clean denatured ethyl alcohol and then drying immediately with a strip of clean lintless cotton tape.

3.4 PERIODIC PERFORMANCE TEST

3.4.1 General

These relays are normally used in circuits provided with spark protective features; accordingly, contacts should require little special attention. Periodic performance checks should include:

a. A check of calibration values at regular intervals.

b. Observation of the general condition of relay operating parts visible through the cover glass to make certain that the spark protective features are functioning.

The sensitive biased relays, such as are used in code line circuits, should have more frequent calibration checks than the less sensitive stick type relays. Recommended rate is once or twice a year initially, with subsequent checks gauged by results of previous records.

3.4.2 Test Procedures

Test the operating characteristics of the KP relays as follows.

3.4.2.1 Recommended Test Equipment

NOMENCLATURE	PART/MODEL/TYPE NO.
Power Supply,, 0-40 Vdc	HP6205B or equivalent
Digital Multimeter (two required)	HP3435A or equivalent
DPDT (Double pole, double throw) Switch	

3.4.2.2 KP Biased Relay Test Procedure. Connect the circuit as shown in figure 2, and proceed as follows:

a. Set M1 to appropriate current range.

b. Set M2 to appropriate voltage range.

c. Set DC power supply to appropriate output range.

d. Set switch S1 to Normal.

e. Turn DC power supply on.

f. Observe M1 (Current Monitor) and adjust DC power supply output control to charge the relay (Charge equals four times pick up or working), see table II or III.

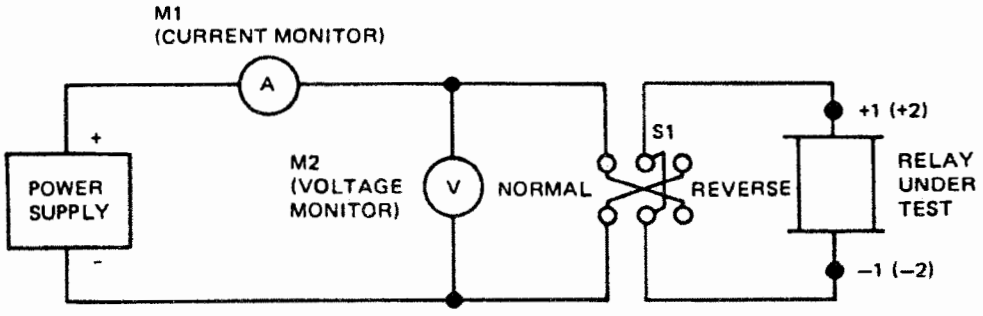
g. Gradually reduce current until front contacts open. This is the dropaway value.

h. Further decrease current, if necessary, until pins touch pole pieces. This is the full dropaway value.

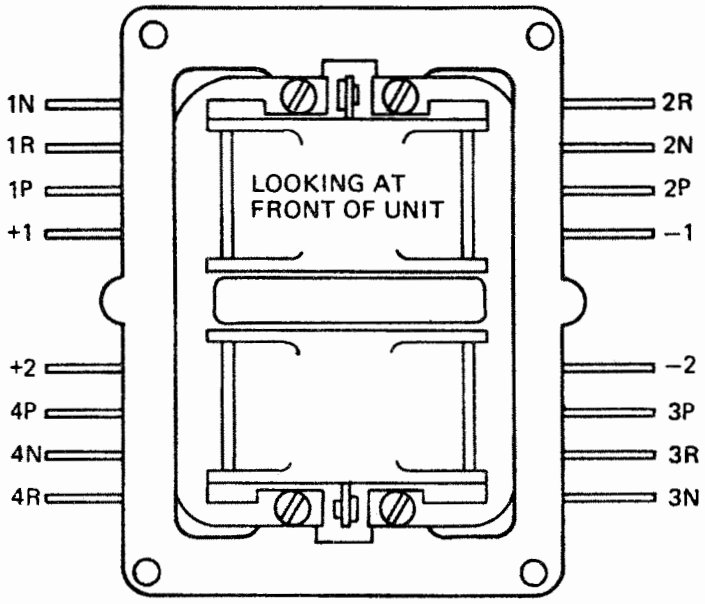
i. Momentarily open circuit, then close it and gradually increase current until relay closes its front contacts. This is the pick up value.

j. Further increase current, if necessary, until the armature stop pins touch the pole pieces. This is the working value.

k. Test concluded. Disconnect test circuit, and return relay to its original location.



A. Test Circuit



B. Terminal Identification

Figure 2. KP Relay Test Circuit

3.4.2.3 KP Stick Relay. Connect relay test circuit as shown in figure 2, and proceed as follows:

a. Set M1 to read in the appropriate D.C. ma range.

b. Set M2 to read in the appropriate D.C. voltage range.

c. Set the D.C. power supply to the appropriate output range.

d. Set switch S1 to Reverse.

e. Turn the D.C. power supply on.

f. Observe M1, Current Monitor, and adjust DC power supply output control to charge the relay (Charge equals four times pick up or working), see table I. Relay should energize in the reverse position.

g. Adjust DC power supply output control to gradually decrease current reading on M1 to zero. Reverse contacts should remain closed.

h. Set switch S1 to Normal.

i. Adjust DC power supply output control to gradually increase current until relay armature picks up and normal contacts close. Current monitor M1 and voltage monitor M2 should indicate the minimum pickup and working values indicated in table I.

j. Adjust DC power supply output control to decrease current reading on M1 to zero. Normal contacts should remain closed.

k. Set switch S1 to Normal.

l. Adjust DC power supply output control to charge relay (see table I).

m. Gradually reduce current to zero. Then reverse polarity and gradually increase current to determine pick up value.

n. The minimum pickup and working values obtained in steps i and m, above, should be as nearly alike as possible.

o. Test concluded. Disconnect test circuit, and return relay to its original location.

SECTION IV

SHOP MAINTENANCE

4.1 INTRODUCTION

This section provides the information necessary to perform shop level repairs of the KP relays covered in this manual. In general, relays arriving at the shop for repair have been checked at the field and have been found to perform unacceptably.

4.2 CLEANING

Before recalibration, all foreign matter should be removed from the interior of the relay, particular attention being paid to the contacts and armature stop pins. Follow up with procedure given in paragraph 3.3.

4.3 INSPECTION

Inspect the relay for signs of physical damage, such as cracked or broken cover, cracked or damaged housing, and damaged and/or missing contact block terminals and indexing pins. If severe damage is found, a careful inspection of the interior components should be made for obvious physical damage.

4.4 TEST EQUIPMENT

The following test equipment is required to perform the tests presented in this section.

Tool to Tool Armature - N243000
Tool to Tool Armature - N243001
Tool to Tool Armature - N243002
Tool to Tool Armature - N347547
Adjusting Tool - N242994
Contact Adjusting Tool - N243059
Spring Gauge - N320728
Inspection Fixture Tool - T35154
Inspection Fixture Tool - T35202

4.5 TESTS AND CHECKS

4.5.1 Fixed Contact Elements

Unless major repairs are necessary, the original calibration values of style KP relays may be obtained by slight adjustment of the fixed contact elements. Contact adjustment tool, M243059 has been specially designed for this purpose. All bending of contact elements should be restricted to the heavier semi-rigid member. The straight flexible contact springs must not be bent.

All adjustments should be made in such manner as to leave the minimum amount of tension or fiber stress in the fixed contact members, by slightly overstressing in the direction of the adjustment and counter-stressing to the final adjustment position. This method minimizes any tendency toward further change in service.

Special armature positioning tools, references for which are given in the calibration tables, are inserted in the magnetic gaps to lock the armature in the correct positions for checking or adjusting the contacts. Leaf gauges should not be used for this purpose.

Two armature positioning tools, one for each end of the armature, should be inserted through the magnetic gaps into the coil spools and pressed firmly in position until all armature motion is taken up. When off-center positions are being checked, care should be taken that the top and bottom tools are so inserted as to provide the same direction of off-center locking in order to prevent damage to the pivots.

The armature positions at which the contacts should just make or break should be the basis for all contact adjustments.

With the armature locked in position, contacts should be adjusted to the point of making; i.e., between a barely visible gap, to the point of just making contact.

4.5.2 Midstroke Adjustment

Relays having the midstroke adjustment can have all contacts checked with one setting of the tools.

4.5.3 Off-Center Adjustment

When off-center adjustments are involved, one setting of the tools will serve for checking the normal contacts, after which the same tools can be used for checking the reverse contacts by reversing the prongs of the tools in the magnetic gaps to lock the armature on the other side of center position.

4.6 REPAIRS AND REPLACEMENT

4.6.1 Dissassembly

Dismantle the relay only to the degree necessary to complete repair. Refer to the parts list for part information and location of parts. In general, to dismantle the KP relay, proceed with the following sequence:

a. Remove relay cover

b. Remove/disassemble relay components as required

c. Remove contacts as necessary.

4.6.2 Reassembly

Reassembly is accomplished generally in the reverse order of disassembly. The following paragraphs provide additional instructions to be followed during reassembly of this relay. Do not overtighten or force parts when reassembling a relay. Upon completion of reassembly, calibrate the relay as directed in paragraph 4.8.

4.6.3 Rotor

If the roter has been damaged, or requires restoration other than by minor bending of springs, it should be replaced. Ordering references for complete rotor assemblies are given in this section for each type of relay.

Before it is assembled to the relay, each complete rotor assembly should be inserted in inspection fixture tool No. T-35154 and the adjustment of the contact springs and flexible connectors checked and, if necessary, adjusted. If any change of more than 0.005 inch is necessary, the rotor should be adjusted and baked at 240° F for six hours, or at 200°F for fifteen hours and then rechecked after baking.

4.6.3.1 Stick Type Relays

All relays with 4N-4R contacts use rotor N191461. All relays with 2N-2R contacts except N341621 and N381621 use rotor N191382. Relay N341621 and N381212 use rotor N341619.

4.6.3.2 Standard Biased Type Relays

Relay Piece Number	Part No. of Complete Rotor Assembly
N191481	N191462
N191494	N191462
N215618	N191462
N215619	N215621
N215620	N215621
N225785	N191462
N226848	N191462
N236321	N236320
*N236656	N236320
N240096	N191462
N294846	N191462
N296500	N191462
N298221	N236320
N298263	N236320
N305256	N191462
N312193	N191462

*This relay is no longer available.

4.6.3.3 Special Biased Type Relays

Relay Piece Number	Part No. of Complete Rotor Assembly
N218749	N191489
N228492	N228493
N302263	N302536

4.6.4 Assembly Procedure

a. Place the contact frame in position on inspection fixture No. T35202 and adjust the contact members both vertically and horizontally so that the contact buttons just touch the spacer in the fixture. Contact adjusting tool, N243059 has been specially designed for this purpose. Stamp the piece number of the relay to be assembled on the top rear surface of the contact frame.

b. Assemble the front trunnion bracket to the contact frame as shown in figure 3. Observe that the screw heads do not extend beyond the front of the contact frame.

c. Assemble the rotor, coils, and yokes to the contact frame as shown in figure 3 without fastening the yokes tightly. If the fit between coils and yokes is too tight, the coil notches should be filed just enough to avoid a force fit.

   Place the rear trunnion bracket in position and with it held firmly against the contact frame, observe, by means of a dial indicator, that the rotor has from 0.005 inch to 0.010 inch end play between the front and trunnions. If the end play is less than 0.005 inch, it may be increased by applying spacer washers under the rear trunnion bracket as shown in figure 3. Also observe that there is at least 0.015 inch clearance between the rotor hub and each coil as called for in figure 3.

d. Insert adjusting tools, No. N242994 in the slots provided at each end of the contact frame. Hold the yokes firmly against these tools and fasten yokes tightly in position.

e. Remove the adjusting tools and place fully charged magnets in position and see that the armature takes either extreme position. With the rotor held in position against one pair of pole faces, fix the position of the rear trunnion bracket by pouring 7% anitmony lead into the holes provided. All stop pins should now touch their respective poles faces when the armature is in either extreme position. If any stop pin is more than 0.002 inch away from its pole face when the opposite stop pin is seated, the rear trunnion should be relocated.

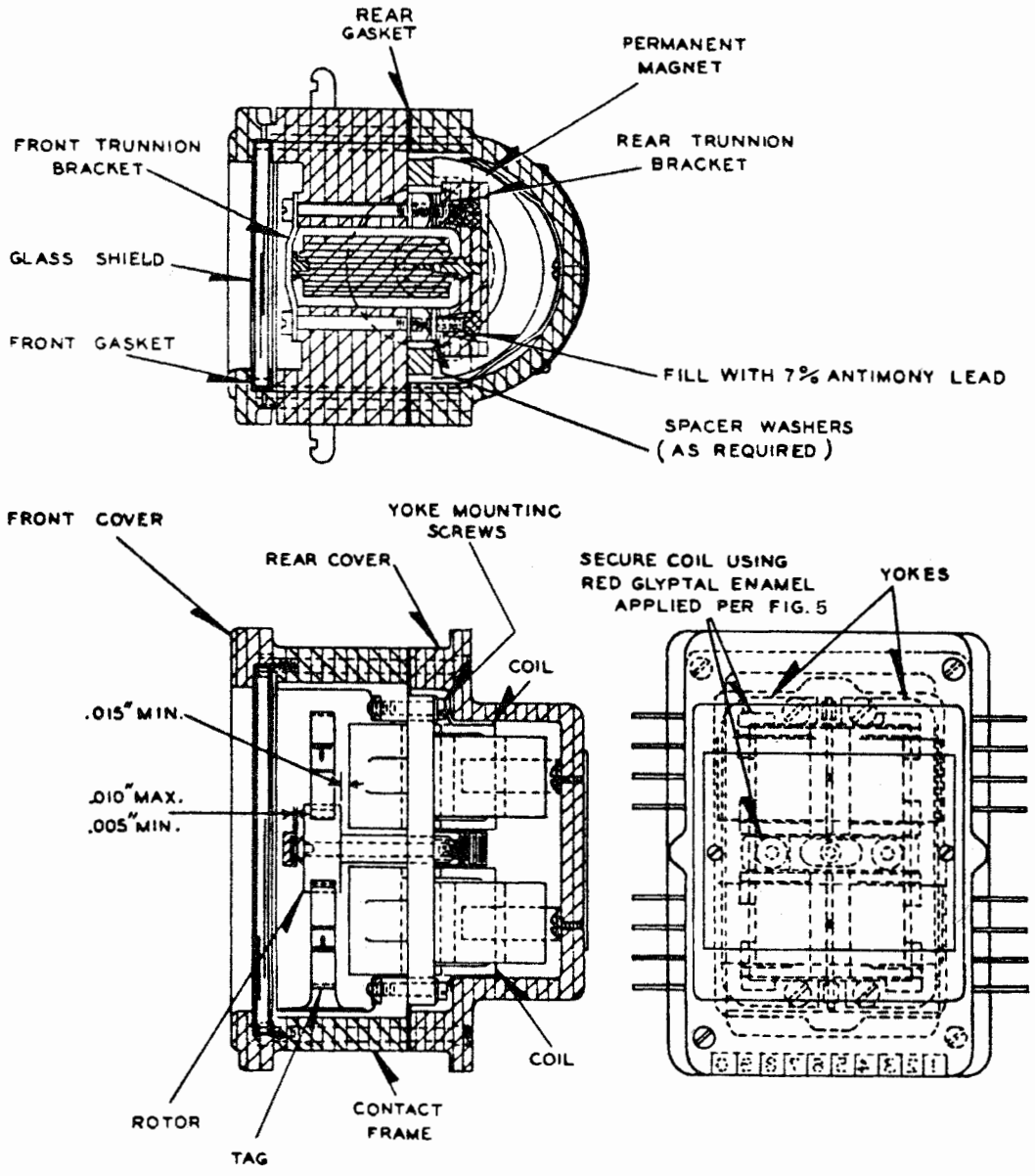


Figure 3. KP Relay

f. Fasten the flexible heel connectors to their frame supports by means of eyelets and then solder. The solder should not run beyond the ends of the supports. All soldering on these relays should be done using a non-corrosive solder flux. It is recommended that solder with a resin -5 core be used. Immediately after a solder connection is made, the soldered area should be cleaned with a clean dry cloth moistened in alcohol.

With the permanent magnets removed, the armature should now take a central position with respect to the pole faces. If the armature is off-center, the brass members to which the heel connectors are attached should be bent until the armature takes a central position with respect to the pole pieces. The bending should be distributed among all members. In no case should the heel connectors themselves be bent.

g. Before soldering, form each coil lead into a loop as follows: Where the lead enters the coil, bend it away from the coild end of a 1/8 inch radius and then form it in a circular loop about 1/4 to 3/8 inch in diameter as shown in figure 4.

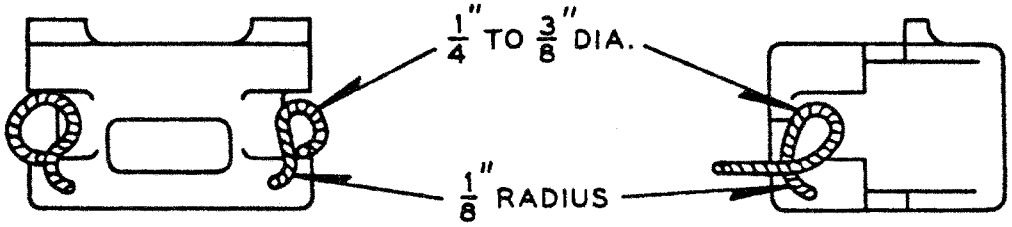
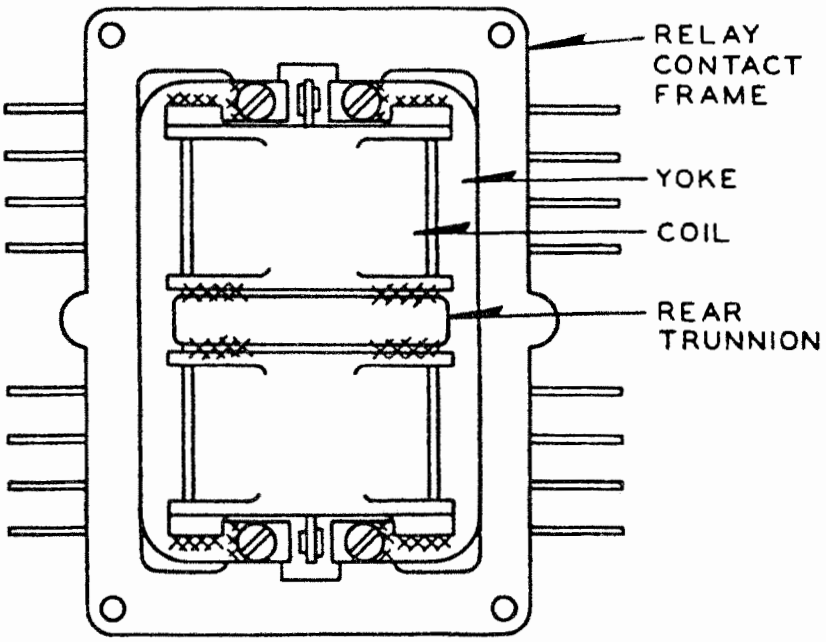


Figure 4. Coil Lead Forming

h. After the relay is assembled, but before the application of the permanent magnets and before heat treating, apply red glyptal enamel A40266, to the back of the relay in eight places, (as shown if figure 5) in order to prevent coil movement under vibration conditions. The enamel should be applied on the outside end of both coils between the yokes and the end of each coil including one edge of the yoke mounting screws and also, between the inside end of each coil and each side of the rear trunnion.

The consistency of the glyptal enamel should be watched carefully. If it becomes "stringy", it is too thick and must be thinned, using a special thinner, A40172.

If it is too thin, it will run through and not perform the intended function of holding the coils firmly in place.



XXXX - Red Glyptal Enamel, A40266

Figure 5. KP Relay, Rear

4.7 ADJUSTMENTS

4.7.1 Contacts

Contacts of various types of relays are adjusted differently to produce different characteristics. This is accomplished by inserting the proper contact adjusting fixtures firmly into the air gaps at both ends of the relay (see figure 6), thus holding the position of the rotor, and then adjusting the fixed contacts so that their contact buttons just touch corresponding contact buttons on the flexible contact members. Contact adjusting tool, No. M243059 has been specifically designed for this purpose. In no case shall flexible contact members be adjusted to align contacts. The contact adjusting fixtures to be used, the deviation permitted from perfect contact adjustment, the heat-treatment required, and the contacts to be adjusted with the adjusting fixtures in a given position are given in the supplementary specifications covering each type of relay.

For stick type KP relays, the contacts which are compressed when the rotor is turned to the clockwise position (as viewed from the front of the relay) are designated "normal" contact, and the contacts which are compressed when the rotor is turned counterclockwise asre designated "reverse" contacts.

For biased type KP relays, the contacts which are compressed when energy is applied to turn the rotor to the clockwise position (as viewed from the front of the relay) are designated "front" contacts and the contacts which are compressed when no energy is applied to the relay (rotor in the counterclockwise position) are designated "back" contacts.

4.7.1.1 Stick Type Relays

a. Relays with 4N and 4R non-independent contacts adjusted to make at 0.025" off-center to provide 0.050" contact opening and 0.030" contact compression. Calibrate per table I-A.

1. Insert contact adjusting tool part number 243001 in air gaps with the stencilled members toward the front of the relay to hold the rotor position 0.025" off-center in the clockwise direction.

2. Adjust all "normal" contact members per paragraph 4.7.1.

3. Reverse the contact adjusting tool so that the stencilled members are toward the rear of the relay to hold the rotor position 0.025" off-center in the counterclockwise direction.

4. Adjust all "reverse" contacts per paragraph 4.7.1.

5. For inspection purposes, all contacts should be within 0.002" of their correct position.

6. After contact adjustment, each relay should be calibrated per paragraph 4.8 and heat-treated at 240^0 for fifteen hours with the rotor in the normal (clockwise) position. The heat treatment should then be repeated with the rotor in the reverse (counter-clockwise) position. The contact adjustment should then be checked and if it is necessary to change the adjustment any contact more than 0.002", the relay should be heat treated again and rechecked.

b. Relays with 2N and 2R independent contacts adjusted to make at 0.005" off-center to provide 0.010" travel between the opening of the reverse contact, and the making of the normal contact, and to provide for 0.030" contact compression and 0.040" contact opening. Calibrate per table I-B.

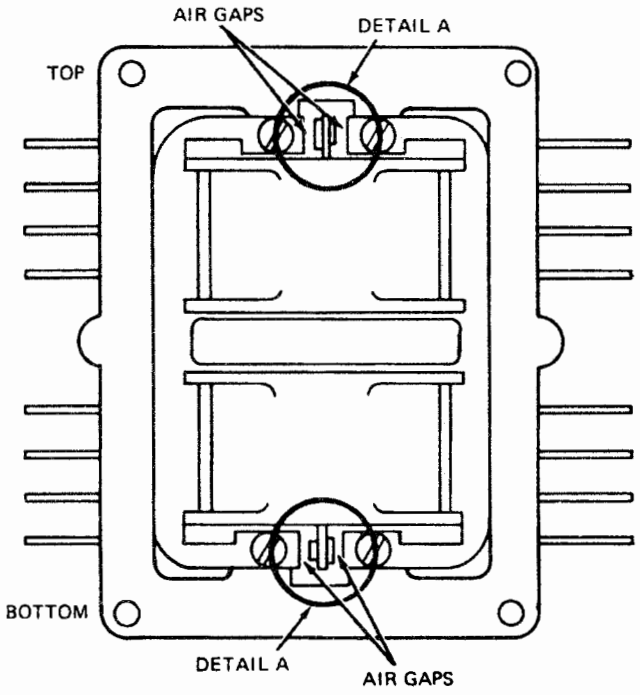
1. Insert contact adjusting tool part number 243002 in air gaps with the stencilled members toward the front of the relay to hold the rotor position 0.005" off-center in the clockwise direction.

2. Adjust all "normal" contact members per paragraph 4.6.4 a.

3. Reverse the contact adjusting tool so that the stencilled members are toward the rear of the relay to hold the rotor position 0.005" off-center in the counterclockwise direction.

4. Adjust all "reverse" contacts per paragraph 4.7.1.

5. For inspection purposes, all contacts should be within 0.002" of their correct position.



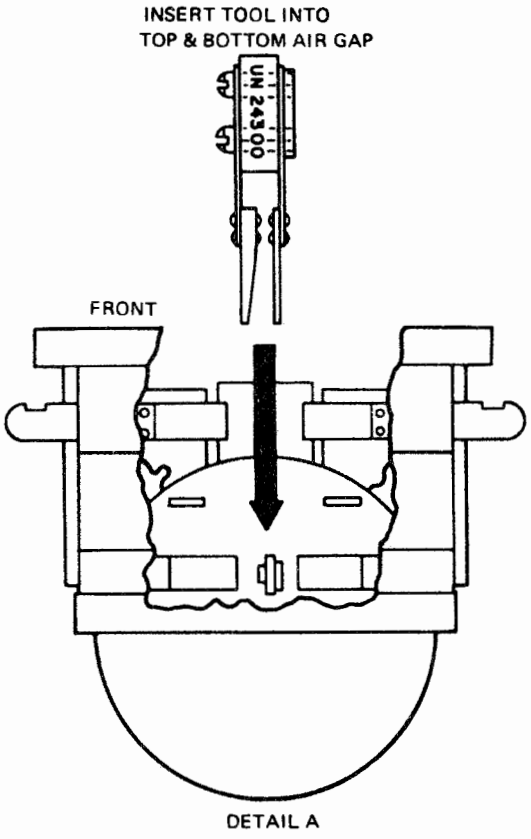


Figure 6. Adjustment Fixture Placement

6. After contact adjustment, each relay should be calibrated per paragraph 4.8 and heat-treated at 240°F for six hours or at 200°F for fifteen hours with the rotor in the normal (clockwise) position. The heat treatment should then be repeated with the rotor in the reverse (counterclockwise) position. The contact adjustment should then be checked and, if it is necessary to change the adjustment of any contact more than 0.002", the relay should be heat treated again and rechecked.

4.7.1.2 Standard Biased Type Relays

a. Relays with 2F and 2F independent contacts, adjusted to make in midposition to provide 0.030" inch compression and 0.030 inch contact opening and no overlap in midposition. Calibrate per table II-A, C and D.

1. Insert contact adjusting tool part number 243000 to hold the rotor in midposition.

2. Adjust all "normal" contact members per paragraph 4.7.1.

3. For inspection purposes, all contacts should be within 0.001 inch of perfect adjustment.

4. After all contact adjustments, the rotors of all relays should be held in the clockwise position using wood wedges and heat-treated at 240° F for six hours or at 200°F for fifteen house and then reheat-treated with the rotors in the counterclockwise position. If it is necessary to change the adjustment of any contact more than 0.002" inch after heat treatment, the relay should be reheat-treated and rechecked.

4.7.1.3 Special Biased Type Relays

With the adjusting tools part number 243003 in position, the contacts should just touch within .001" and there should be approximately 0.005" clearance between the load springs (springs wihout silver buttons) and their stop members. The position of the stops should be such that they will contact the load spring approsimately 1/8" inside of the end of the spring.

After contact adjustment, the rotors of all relays should be held in the clockwise position using wood wedges and the relays heat-treated at 240°F for six hours or at 200°F for fifteen house and then reheat-treated with the rotors in the counterclockwise position. If it is necessary to change the position of any contact more than 0.002" after heat treatment, the relay should be reheat-treated and rechecked.

4.8 CALIBRATION

4.8.1 Permanent Magnet Calibration and Adjustment

a. Permanent magnets should be assembled on the relay with the poles marked "N" to the right as viewed form the front of the relay. The poles marked "N" should attract the end of a magnetic compass which points toward geographic South.

b. Relay calibration is finally determined by adjusting the strength of the permanent magnets. A pair of magnets should be placed over the coils of a relay to check if they seat squarely against the yokes. They should then be charged to full saturation, and each magent partially demangetized by applying a convenient value of alternating flux to the magnets. If a magnet is discharged too far, it should again be charged to full saturation and discharged with a slightly lower value of alternating flux.

c. The magnets should be assembled on the relay with the like poles in the same direction so that, with the relay in the normal operating position and with positive energy applied to the left of either coil, the armature will rotate to the clockwise position as viewed from the front of the relay.

d. In checking calibration, the energizing circuit should be opened for one second before reading the pick-up value; and the relay should be energized to four times maximum pick-up beofre reading the drop-away value.

4.8.2 Stick Type Relays

The relay pick-up (reversal) calibration should be checked in both directions (clockwise and counterclockwise) using each coil separately. The pick-up values must fall within the limits specified in table I. If either or both are too high, the magnets should be further demagnetized with a slightly higher value of alternating flux. If either or both are too low, the magnets must be agian fully charged and demagnetized with a slightly lower value of alternating flux.

For those relays which require a higher pick-up in one direction than the other, the fixed contact members may be adjusted slightly.

4.8.3 Standard Biased Type Relays

Three points are taken on pick-up as follows: Start, Pick-up (close front contacts), and Working (Full Stroke). Two points are taken on drop-away as follows: Drop-away (open front contacts), and Full Drop-away. The pick-up and drop-away calibration values should be checked for both front contacts and must fall within the limits specified in table II. If the start value on pick-up is too high, the magnets should be further demagnetized with a higher value of alternating flux. If the start value on pick-up is too low, the magnets should again be fully charged and demagnetized with a smaller value of alternating flux.

4.8.4 Special Biased Type Relays

The pick-up drop-away values must be within the limits shown in table III. On pick-up, the amount of current required to close the front contact (pick-up value) must also complete the stroke (working value). Likewise, on drop-away, the amount of current required to open the front contact (drop-away value) must also complete the stroke (full drop-away value). In case this action cannot be obtained, the stops for the load springs may be adjusted to contact the load springs nearer the free end. In no case should they be closer than 1/32" to the free end of the load springs.

4.8.5 Calibration Tables

KP relays calibration should be checked by the usual calibration equipment. The calibration values should be taken on each coil separately in accordance with the accompanying tabulations.

For normal polarity, apply positive battery to the left-hand terminal of either coil. This will rotate the armature of any KP type relay clockwise. For reverse polarity, apply negative battery to the left-hand terminals. This will rotate the armature counterclockwise.

The stick relay should first be charged at reverse polarity to approximately four times maximum pick-up value and the current then gradually reduced to zero. Reverse the polarity, then gradually increase the current until the armature moves to the clockwise position to determine the normal pick-up value. The armature should go to full stroke at this same value and should remain at full stroke when the relay is deenergized. The relay should then be charged at normal polarity by increasing the current to approximately four times maximum pick-up value. Then the current should be gradually reduced to zero. Reverse the polarity and gradually increase the current until the armature moves to the countercloskwise position to determine the reverse pick-up value. The armature should go to full stroke at this same value and should remain at full stroke when the relay is deenergized.

The biased relay should first be charged at normal polarity to approximately four times maximum pick-up value, and the current then gradually reduced until the front contacts open to determine the drop-away value. Further decrease the current, if necessary, until the armature stop pins touch the pole pieces to determine the full drop-away value. Open the circuit momentarily, and then close it and gradually increase the current until the relay closes its front contacts to determine the pick-up value. Further increase the current, if necessary, until the armature stop pins touch the pole pieces to determine the working value.

Biased relays return to the counterclockwise position when energy is removed and will not pick-up when reverse energy is applied.

Table I. Calibration Values for Stick Type KP Relay Values

A. 4N-4R Non-Independent Contacts - Approximately 0.050" Opening. Adjust per paragraph 4.7.1.1.a.

Pc. No.	Code No.	Coil Resistance - Ohms		Pick-Up (One Coil) Milliampers	
		Upper	Lower	Max.	Min.
N191362	45690	20	20	82	68
N294847	12368	20		82	68
			105	39	31
N191493	45680	105		39	31
			20	82	68
N217122	12347	105	105	39	31
N231072	12356	105		39	31
			1070	12.3	9.8
N191500	45780	1070	1070	12.3	9.8
N314119	12370	3800	3800	7.2	5.7
N335380	12380	400	400	22	16
N341621*	12456	1070	1070	10.5	7.5
N381212*	-----	1070	1070	10.5	7.5

B. 2N-2R Independent Contacts - Approximately 0.040" Opening. Adjust per paragraph 4.7.1.1.b.

N225784	12345	12.5	12.5	36	29
N191499	45789	20	28	28	22
N262433	12360	105	105	13.3	10.8
N292335	56890	400	400	7.3	5.9
N220821	56780	1070	1070	4.6	3.4
N337612**	12390	400	400	7.3	5.9

* Two normal and two reverse contacts removed.
** Magnets and polarity reversed.

B. Special Relay (Off-Center Adj.) 2N-2R Independent Contacts Approximately 0.040" opening. See paragraph 4.8.2 Adjust Per Paragraph 4.7.1.1.b.

Pc. No.	Code No.	Coil Resistance - Ohms		Pick-Up (One Coil) Milliamperes			
				Counterclockwise		Clockwise	
		Upper	Lower	Max.	Min.	Max.	Min.
N231412	12357	73		12.1	9.9	19.2	15.9
			33	18.1	13.9	28.2	22.5

Table II

Calibration Values for Standard Biased Type KP Relays
Adjust Per Paragraph 4.7.1.2

Part No.	Code No.	Coil	Res. Ohms	Pick-Up Milliamperes				Drop-Away Milliamperes	
				Start		Closed Front Contacts		Wkg. Max.	Full Drop-Away Min.
				Max.	Min.	Max.	Min.		
N226848	45670	Upper	0.86	164	125	164	125	195	60
		Lower	0.86	164	125	164	125	195	60
N312193	12379	Upper	3.2	90	67	90	67	107	32
		Lower	3.2	90	67	90	67	107	32
N225785	23456	Upper	12.5	46.0	34	46	34	51	16.0
		Lower	12.5	46.0	34	46	34	51	16.0
N191494	56789	Upper	20	34	26	34	26	42	12.5
		Lower	20	34	26	34	26	42	12.5
N294846	12367	Upper	20	34	26	34	26	42	12.5
		Lower	3800	2.9	2.2	2.9	2.2	3.5	1.1
N215618	12348	Upper	105	16.0	11.5	16.0	11.5	19	5.8
		Lower	105	16.0	11.5	16.0	11.5	19	5.8
N296500	12369	Upper	105	16.0	11.5	16.0	11.5	19	5.8
		Lower	1070	5.1	3.9	5.1	3.9	6.1	2
N321408	12389	Upper	105	16.0	11.5	16.0	11.5	19	5.8
N380716		Lower	3800	2.9	2.2	2.9	2.2	3.5	1.1
N191481	57890	Upper	1070	5.1	3.9	5.1	3.9	6.1	2
N374213	-----	Lower	1070	5.1	3.9	5.1	3.9	6.1	2
N240096	12340	Upper	3800	2.9	2.2	2.9	2.2	3.5	1.1
N381593		Lower	3800	2.9	2.2	2.9	2.2	3.5	1.1

Table II (Continued)

Special Sensitive Relays - 2F-2B Independent Contacts
Approx. 0.30 Inch Opening
Adjust Per Paragraph 4.7.1.2

Part No.	Code No.	Coil	Res. Ohms	Pick-Up Milliamperes				Drop-Away Milliamperes			
				Start		Closed Front Contacts		Wkg. Max.	Open Front Contacts		Full Drop-Away Min.
				Max.	Min.	Max.	Min.		Max.	Min.	
N215619	12349	Upper	105	11	6.8	11	6.8	14.2	4.6	3.4	1.9
		Lower	105	11	6.8	11	6.8	14.2	4.6	3.4	1.9
N215620	12346	Upper	105	11	6.8	11	6.8	14.2	4.6	3.4	1.9
		Lower	3.2	61	38	61	38	80	26	19	10.8

Special Single Contact Button - 2F-2B Independent Contacts
Approx. 0.030 Inch Opening
Adjust Per Paragraph 4.7.1.2

Part No.	Code No.	Coil	Res. Ohms	Pick-Up Milliamperes				Drop-Away Milliamperes			
				Start		Closed Front Contacts		Wkg. Max.	Open Front Contacts		Full Drop-Away Min.
				Max.	Min.	Max.	Min.		Max.	Min.	
N236321	12358	Upper	105	9.2	6.8	9.2	6.8	14.2	4.6	3.4	1.9
		Lower	105	9.2	6.8	9.2	6.8	14.2	4.6	3.4	1.9
**N236656	12359	Upper	1070	2.6	1.9	2.6	1.9	4.1	1.3	1.0	0.5
		Lower	1070	2.6	1.9	2.6	1.9	4.1	1.3	1.0	0.5
*N298221 N298263	-----	Coils in Multiple	535	3.5V	3.0V	3.5V	3.0V	4.2V	---	1.3V	1.0V
N318066	-----	Upper	1070	2.9V	2.0V	2.9V	2.0V	4.1V	---	1.0V	0.5V
		Lower	1070	2.9V	2.0V	2.9V	2.0V	4.1V	---	1.0V	0.5V

* Two relay units Pc. # N298221 are bolted front to front to form one dual relay Pc. #N298263. The tabluated calibration values in volts are used for each half with the coils connected in multiple.

** This relay no longer available.

Table III

Calibration Values for Special Biased Type KP Relays -
One Front Contact Only

Part Number	Code Number	Coil	Res. Ohms	Pick-Up & Working Milliamperes		Drop-Away & Full Drop-Away Milliamperes	
				Max.	Min.	Max.	Min.
N218749	12340	Upper	105	30.5	24.5	15.5	11.0
		Lower	105	30.5	24.5	15.5	11.0
N228492	67890	Upper	1070	3.1	1.9		0.5
		Lower	1070	3.1	1.9		0.5
N302263	12378	Upper	3800	2.1			0.2
		Lower	3800	2.1			0.2

4.9 OPERATIONAL TEST

4.9.1 General Inspection

a. A general inspection of the contacts shall be made after adjustment to see that they are properly aligned and meet squarely. The relay calibration should then be checked. Slight adjustment of the fixed contact members should be sufficient to meet the calibration.

b. It should be noted that all lock washers are used where required, and that they are fully compressed.

c. The coil leads should be arranged so that they cannot vibrate into such a position as to interfere with operation of the contacts.

d. Flexible connectors should be examined to see that they are formed to provide adequate clearances and are properly soldered.

e. The tag should be marked with the code no. and serial no. of the relay, together with data and inspector's initials. This tag should be inserted in the bottom of the relay as shown in figure 4.

f. A careful inspection should be made to be sure that all dirt and foreign matter has been removed form the mechanism, paying special attention to air gaps and contact surfaces.

4.9.2 Final Inspection

a. The front cover and back should be carefully assembled so that all gaskets lie smoothly and are compressed, sealing the relay tightly. Observe that the gasket does not extend beyond the edges of the relay.

b. After sealing, the relay should be examined through the cover to see that contacts, flexible connectors, and coil leads have not been misplaced since calibration.

c. A final check of relay calibration should be made.

SERVICE MANUAL 3623
Appendix A

Parts List

KP RELAY

Part Numbers

N220821	N294846
N191481	N225785
N191493	N296500
N191499	N347480
N191500	N231412
N215618	N217122
N371940	N240096

UNION SWITCH
& SIGNAL INC.
A member of the ANSALDO Group

5800 CORPORATE DRIVE
PITTSBURGH, PA 15237

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Parts List For KP Relay

Reference	Relay Part Number	No. Contacts	Coil Ohms	
			Upper	Lower
A	N191481	2N & 2B, I*	1070	1070
B	N191493	4N & 4R, N**	105	20
C	N191499	2N & 2R, I*	20	20
D	N191500	4N & 4R, N**	1070	1070
E	N215618	2N & 2B, I*	105	105
F	N217122	4N & 4B, N**	105	105
G	N220821	2N & 2R, I*	1070	1070
H	N225785	2N & 2B, I*	12.5	12.5
J	N231412	2N & 2R, I*	75	33
K	N240096	2N & 2B, I*	3800	3800
L	N294846	2N & 2B, I*	20	3800
M	N296500	2N & 2B, I*	105	1070
N	N347480	4N & 4R, N*	20	20
P	N371940	4N & 4R, N**	12.5	12.5

*I = Independent Contacts
**N = Non-Independent Contacts

Parts List for KP Relays
(See Figure A1)

Item No.	Part No.	Description	Used on Relay Ref.
1	N191363	Frame	B,D,F,N,P
1	N191480	Frame	A,C,E,G,H,J,K,L,M
2	N191462	Rotor Comp	A,E,H,K,L,M
2	N191461	Rotor Comp	B,D,F
2	N191382	Rotor Comp	C,G,J
2	N347479	Rotor Comp	N,P
3	N220783	Coil	A,D,G,M
3	N191479	Coil	B,E,F,M
3	N226572	Coil	B,C,L,N
3	N191498	Coil	H,P
3	N321410	Coil	J
3	N231411	Coil	J
3	N248743	Coil	K,L
4	N191385	Yoke	ALL
5	N286398	Screw	ALL
6	J047662	Washer-6PS LK	ALL
7	M151836	Nut	ALL
8	M191464	Permanent Magnet	ALL
9	M241325	Pivot Bracket	ALL
10	N191429	Pivot Bracket Comp	ALL

Parts List for KP Relays
(Continued)

Item No.	Part No.	Description	Used on Relay Ref.
11	M242271	Nut	ALL
12	M273771	Screws	ALL
13	M248353	Cover	A
13	M248362	Cover	B
13	M248364	Cover	C
13	M248365	Cover	D
13	M248354	Cover	E
13	M248357	Cover	F
13	M248358	Cover	G
13	M248361	Cover	H
13	M248368	Cover	J
13	M248371	Cover	K
13	M294844	Cover Back	L
13	M296501	Cover	M
13	M347549	Cover	N
13	M371941	Cover	P
14	J047081	Gasket-Rubber	ALL
15	J776373	Cover-Front Clear	ALL
16	J047355	Gasket-Molded Rubber	ALL
17	J480006	Nut-4-40 Hex Steel	ALL
18	J522142	Screw-4-40 Hex Steel	ALL
19	J070883	Eyelet-Brass	ALL
20	J062742	Plate-Alum Name	ALL
21	J075599	Tag with Opq Acetate	ALL
22	M233946	Washer	ALL
23	M233947	Washer	ALL
24	M317304	Washer	ALL
25	M279717	Springs	ALL
26	J525024	Screw-4-40 X 3/16RDH Par	ALL

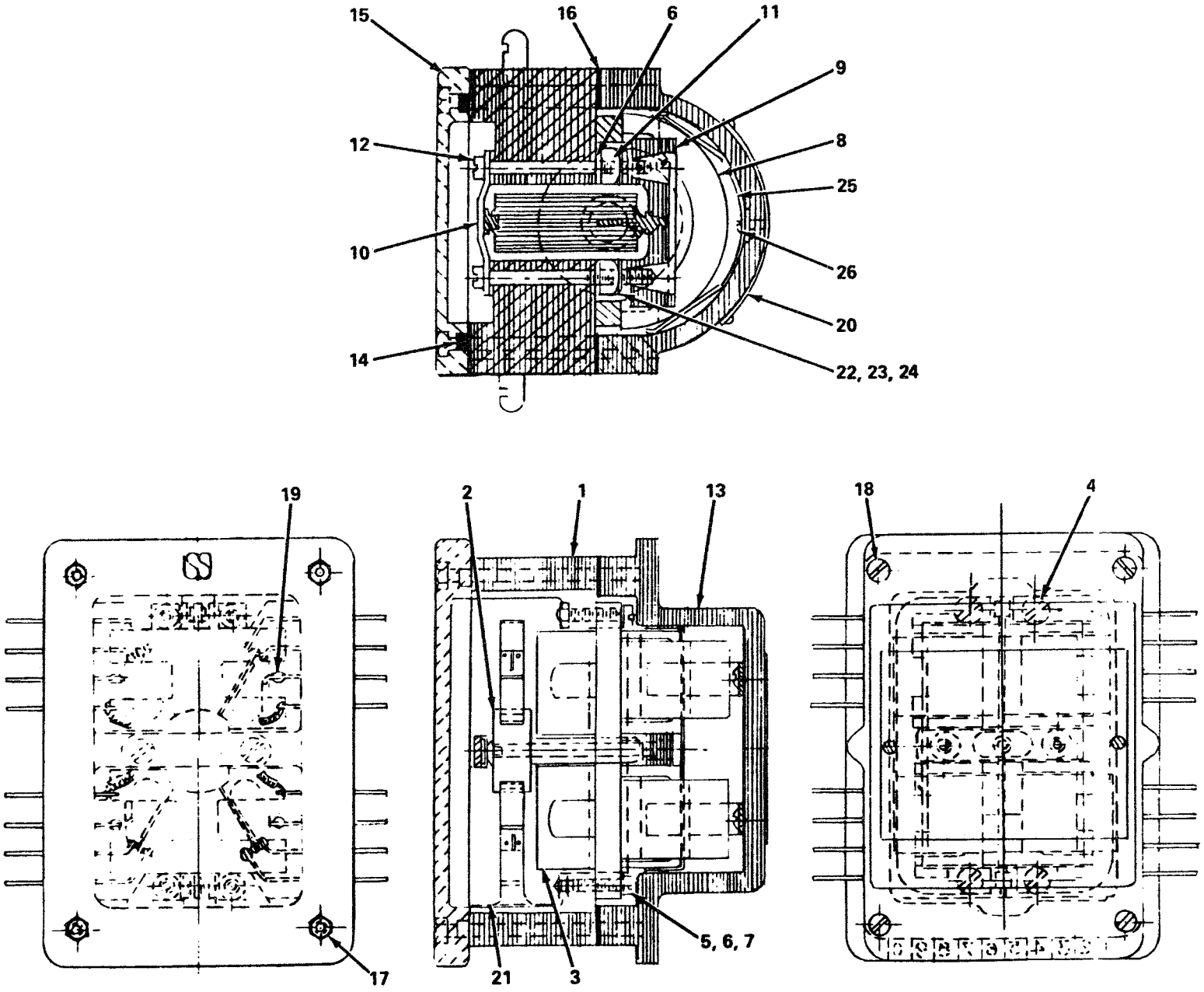

Figure A1. KP Relay Parts Location